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AUTHOR Cuthbert, Rob
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ABSTRACT

The matrix structure as an alternative to the departmental structure for colleges and universities is discussed, and the matrix system at Middlesex Polytechnic in England is used as illustration. The major impact of the introduction of a matrix structure is its effect on teaching activities within the institution. The matrix structure formally separates the roles of subject leader and course leader. The role of subject leader is to service the courses by providing the teaching staff. The matrix is designed to make the course, rather than the department, the basic unit of organization. Insofar as research in higher education is essentially an individual activity separately funded, the effects of a move from departmental to matrix organization are likely to be slight. For the library, the matrix will mean ending the familiar patterns of contact with departmental representatives. New links must be established with course and subject staff. The matrix may force out into the open difficult decisions over conflicting demands (especially teaching versus research). The following influences on organization structure in higher education are considered: people, technology, coordination, environment, size, dispersion, and tradition. (SW)

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# MATRIX MANAGEMENT STRUCTURES IN HIGHER EDUCATION

Rob Cuthbert
Staff Tutor
September, 1979.

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## I. INTRODUCTION

Organisation structure is as much a state of mind as a disembodied set of relationships. In all of our universities and colleges until recently, and in most of them today, the formal structures of organisation betray that state of mind of which Jay (1967, p.73) wrote:

> "They may not put it down on paper, they may not even mention it in discussion, but a great many administrators and managers carry in their heads a pattern of the 'ideal' organisation. That pattern is the classic hierarchy, the family tree; one man at the top, with three below him, each of whom has three below him, and so on with fearful symmetry into the seventh generation..."

True, the hierarchies in higher education are muted in ways we shall explore, and sufficiently so to have allowed the universities and colleges to survive, adapt and develop over many years of increasingly rapid social change. Yet if we are now, for the first time, 'beyond the stable state' as Schön (1970) suggests, then perhaps it is time to reconsider the social and the mental structures which have served us well in the past. There are alternatives to the classic pyramidal hierarchy, and even if we cannot wholly agree with those (Argyris (1967), Beer (1974)) who sound its death knell, we must recognise the existence of the alternatives and their potential superiority for at least some purposes. Whether higher education is a suitable case for treatment, and what alternatives there are in the HE context, are the two central questions addressed in this paper. Separate sections will consider in turn the alternative structural possibilities, the influences on organisation structure in HE, and the implications of one new form - the matrix - which is emerging as the main challenger to the conventional pyramid. First, though, a modicum of history is necessary to place these recent developments in context.

For a long time the history of higher education was the history of the universities. The medieval origin of the ancient university was the small collegial community of the studium generale. The gradual growth and development of the university led to the appointment of assistants to professors, whose status later became regularised in non-professorial teaching posts. The university experience, while still reserved for a tiny elite, came to be, and to be seen as, more than the medieval licence to teach (see Robertson (1944)). Growing size brought departmentalisation and increasing formal hierarchical differentiation. The university became, if not a bureaucracy, an increasingly bureaucratic federation of fairly autonomous hierarchical units. The discipline-based department became the basic building block for the redbrick universities (see Truscot (1951)), with only Durham opting for the collegial structure which emphasises residence in the 'community of scholars' as an integral part of the university experience. The special academic freedoms of the university became not much more than a reflection of liberal norms in the wider society, and universities became subject to new social pressures - for expansion, for greater lay control, and for a more participative style of internal government. Higher

education outside the universities grew as demand outstripped universities' capacity to respond. The structures of the non-university institutions providing higher education followed the university departmental model, and the first wave of these institutions achieved their goal of university status as a result of Robbins' (1963) recommendations for the colleges of advanced technology. The creation of the new universities in the early 1960s broughtthe first widely-remarked structural innovation in HE as Sussex University experimented with a 'schools' structure which sought to break down some of the departmental barriers to communication and development. Yet it seems that departmental boundaries soon reasserted themselves (see Moodie and Eustace (1974, p.71-72)) and it was left to the non-university sector in the middle and late 1960s to develop a possibly more durable innovation.

The rapid growth of higher education in the 1960s put a premium on responsiveness to societal needs and relevance to students' demands. Some institutions found departmental structures inhibiting in developing the new courses needed to meet these new pressures. The influx of new staff and students, less encumbered by tradition, made it possible for some existing colleges to undergo radical reorganisation. One example was Enfield College of Technology, where a matrix structure was introduced by proponents of a new philosophy for the then new polytechnics (see Robinson (1968)). The creation of the polytechnics provided an opportunity, seized by several, to experiment with the matrix form of organisation which had first come to prominence in the Americam aerospace industry in the early 1960s.[1] Among the polytechnics to adopt a matrix structure was Middlesex (which incorporated the former Enfield College of Technology), which will be used to illustrate several of the points made in the ensuing discussion. Matrix structures have persisted into a recessionist climate very different from that in which they were introduced, and the new circumstances pose new questions for old and new structures alike. What difference do the new structures make for the basic teaching activities? What is the best way to organise to cope with increasingly large-scale activities? What kind of organisation is best fitted to assimilate other activities by institutional merger? How can we promote development without growth? We can try to answer some of these questions in what follows. Section II considers some alternative possible structures, briefly reviewing the notable features of the familiar departmental organisation and then describing matrix organisations in general, and the Middlesex matrix in particular. The novelty of the matrix can make it difficult to comprehend and to evaluate, and Section III aims to simplify the evaluation process by offering a 'checklist' of the key factors to be taken into account. Section IV draws these 'notes towards an evaluation' together by examining the implications of matrix organisation for teaching, research and supporting activities. In conclusion some alternative strategies for change are briefly considered. The treatment throughout regards department and matrix as polar opposites. This unduly sharp distinction is made both as a helpful expository device and because, for many principals and others contemplating the introduction of a matrix, the purpose is a major and discontinuous change in existing patterns of work. Those for whom the department is, as it can be, an unconstricting, strong but flexible

base for operations, would hardly need to consider a far-reaching change in formal structure if the informal reality were a point midway on the continuum between department and matrix. This paper is meant for those who feel the need at least to consider a more radical alternative to a rigid departmentalism.

## II. ALTERNATIVE STRUCTURES

### II.i. The Departmental Structure

The great strength of the department is also its great weakness - autonomy. Many teaching staff and most students will rarely, if ever, need to step outside the boundaries of their department. For staff the department is the base for teaching and research, and for career progression, whether the member of staff has a 'cosmopolitan' or 'local' orientation, to use Gouldner's (1957) distinction. For the student the department is the only unit, other than the course, likely to have any meaning and observable effect. The head of department dominates the communication channels between top and bottom of the organisation, and the post of head of department is more often than not the highest career point reached by those at this level. The post of head of department is furthermore a comfortable and acceptable stopping-point for many, particularly those whose main interests are in developments within their discipline. The heads collectively dominate broader decision making processes, in academic boards, senates and in less formal but powerful executive groups. These considerations indicate some of the sources of power of the department, and the inherent structural conservatism of a departmental structure. There is clearly a danger that the strength of departmental boundaries will prevent desirable inter-departmental co-ordination, whether in teaching or research. One solution to this problem might be simply to expand departments until they are large enough to permit inter-disciplinary co-operation within the confines of the department, but expansion also builds up pressures for fragmentation to provide more career opportunities. An alternative widely employed is to group departments within a faculty structure. Whether the existence of faculties strengthens inter-departmental links is likely to depend on whether or not a full-time head of faculty is appointed, whether he or she enjoys some powers of resource allocation, and whether a supporting administrative structure is built up at faculty level. In any case, faculty groupings do no more than tinker with the fundamental departmental structure; more radical alterations are conceivable.

This brief sketch of the features of departmental organisations will be amplified by comparison and contrast with the radical alternative represented by matrix structures.

II.ii. What is A Matrix Structure?

The operation of a matrix structure is most easily explained by a series of diagrams. The term 'matrix' comes from mathematics, in which a matrix is an ordered array of elements making up a recognisable whole. The simplest matrix has two dimensions, which we can think of as rows and columns, and we can use such a matrix to describe the teaching activities in a university or college (see Figure 1). Each column represents one course, and each row represents a subject. The intersection of a row and column records the amount of a given subject required by the given course. In Fig. 1, for example, the BSc. Economics requires 85 units of Economics teaching, 12 units of Sociology and so on. The complete matrix describes the totality of teaching activities in the institution, and such a description is of course possible irrespective of the structure of the organisation. In a departmental structure the emphasis is on the diagonal of the matrix, as Figure 2 shows. Most teaching is contained within the boxes on the diagonal: other entries in the matrix represent 'service teaching' by staff of one department on another department's courses. Service teaching is limited to such an extent that it makes sense to assign organisational responsibilities 'box by box' - each box is a department, and heads of department negotiate arrangements for such service teaching as they require. The generally low status of service teaching is a predictable consequence of making the department the key unit. Not only will service teaching usually be at a less exalted academic level, it will also be less likely to impress the head of department whose opinion counts in the promotion stakes. If promotion depends, as it often does, on publication and research or on course administration, then those with strong intra-departmental subject interests are favoured. The head of department of economics is more likely to be the economist who taught the final year BSc. Economics than the economist who taught introductory economics to first year students in the Catering department. In any case, the good teacher who is promoted will find himself doing less teaching, as administration in the two dimensions takes its toll.

| Courses / Subjects | BSc. Econ. | BA. Sociology | ... |
|---|---|---|---|
| Economics | 85 | - | ... |
| Sociology | 12 | 64 | ... |
| ... | | | |

Figure 1

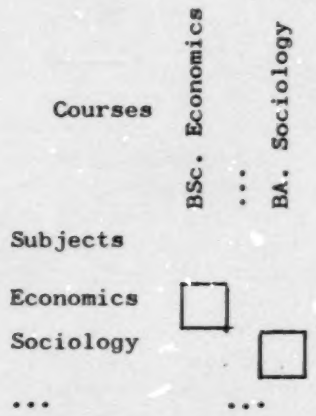


Figure 2

For these familiar reasons the institutional matrix has in some cases been formalised in a different way. Clearly, one way to improve the status, and hence perhaps the quality, of economics teaching outside the economics department, is to reduce the tendency of the subject leader to concentrate on the BSc. Econ, and to increase the tendency of all course leaders to concentrate on the best interests of their students. The 'matrix structure' does this by formally separating the roles of subject leader and course leader. This is represented diagramatically in Figure 3. No-one may be simultaneously a subject leader and a course leader, and so the role of head of department is abolished. In a sense

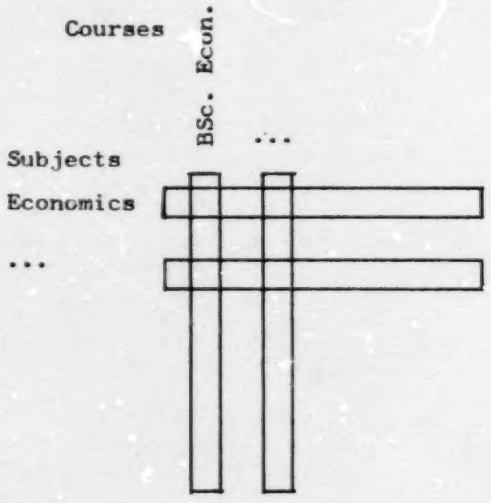


Figure 3

all teaching becomes service teaching: the role of subject leaders is to service the courses by providing staff to teach on them. The formal structure legitimates two perspectives on the organisation: the course management perspective sees the basic activity as the organisation, co-ordination, operation and monitoring of courses; the resource management perspective emphasises the recruitment, development and deployment of appropriate staff and other resources. Tension between these perspectives exists in any organisation - in a departmental structure the tension is resolved by creating autonomous local units with two-dimensional responsibilities, but in a matrix structure the tension is resolved by creating institution-wide but strictly one-dimensional roles, and leaving conflicts to be settled by negotiation between the role incumbents. The matrix therefore makes it the rule, rather than the exception, that any teacher is likely to have more than one boss. For this reason matrix structures are often described as 'dual authority' structures.[2] The full rationale and implications of matrix organisation are developed in the following sections, but first one specific example - the matrix at Middlesex Polytechnic - will be briefly described so that it may be subsequently used as a concrete illustration of some of the points to be made.

II.ii. The Middlesex Polytechnic Matrix

Middlesex Polytechnic has over 5,000 students and over 700 teaching staff. Staff are grouped in about 25 subjects, each headed by an elected subject chairman. There are six appointed permanent Deans, each of whom takes responsibility for a 'resource centre' - a group of related subjects - the Dean of Business Studies and Management, for instance, is responsible for staff in Accounting, Catering, Law, Management and Marketing. Each Dean has two or more Assistant Deans to help in deploying staff and other resources to courses and other activities. The role of subject chairman is not formally prescribed and varies from area to area. Individual courses, or groups of related courses, are headed by appointed permanent Course Leaders - there are over fifty such posts. All Deans and Course Leaders are responsible directly to the Deputy Director. Libraries, student services and other activities form a 'third dimension' of the matrix, being grouped and managed separately, responsible to an appropriate Assistant Director. Responsibility for directing and promoting research is assigned to the Deans, who are also formally responsible for the development of new courses.

There are six Faculty Boards, each covering a specific group of courses. The chairman of each Board is the 'most appropriate' Dean, the subject grouping being such as to make it clear which Dean should by this criterion chair which Board. The 'purity' of the matrix is thus impaired in two ways:

- each Dean is not only a resource manager but also the manager of a major activity (research);
- each Dean, by chairing a Faculty Board, has a greater interest in one localised area than in other parts of the Polytechnic also serviced by the Dean's subject groups.

The arrangements are summarised in Figs. 4 and 5.

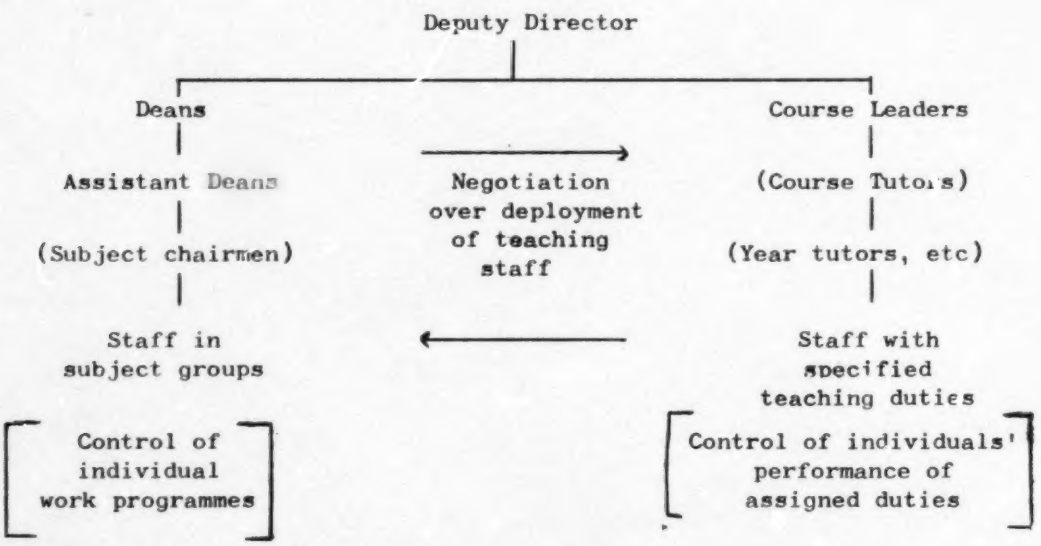


Figure 4

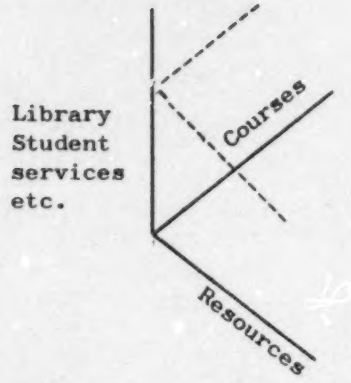


Figure 5

The structure may be thought of as a cube, in which each dimension has a separate 'chain of command'. The three chains come together only at Deputy Director level. Most staff have roles in two or three of the dimensions - as teacher of a course syllabus, as member of a subject group, as part-time student counsellor, etc. Note that each dimension retains its hierarchy of control in formal terms. However the effect of overlaying these three formal hierarchies is, to some extent, to depersonalise the hierarchy. The Dean may in one dimension control the work programme of a course leader, but in another dimension the course leader may control the work of the Dean who teaches on his course. One teacher may therefore occupy roles at very different levels, and labels such as 'senior lecturer' or 'head of department' describe only salary grades, and not a particular role or status. The structure emphasises and relies upon the autonomy and responsibility of the individual to cope with and resolve conflicting demands.

## III. SOME INFLUENCES ON ORGANISATION STRUCTURE IN HE

### III.i. People

Studies of teaching staff in higher education range from worthy but sometimes dull sociology (e.g. Halsey and Trow (1971)) to more entertaining but highly personal reflections (Cornford (1908)). Gouldner's (1957) famous typology distinguished the 'cosmopolitans', who saw their career in terms of progression within their discipline area, from the 'locals' who were more committed to a particular organisation and more likely to seek advancement within that organisation, and less committed to remaining within their initial subject specialism. Clearly an institution staffed predominantly by 'cosmopolitans' is more likely to have a structure which provides clear demarcation of discipline boundaries and greater opportunities for career progression within these boundaries. It is also likely to have a fairly high turnover of staff, and will therefore need readily comprehensible structures to facilitate rapid induction of new staff. For all these reasons the preference of cosmopolitans will be for a weak federation of strong departments. Locals, on the other hand, will be less concerned to maintain subject boundaries and perhaps more prepared to experiment with structures which make their institution noticeably different from others, particularly if these increase career opportunities within the organisation.

Halsey and Trow (1971) make different distinctions in their typology of academic orientations: academics, they say, may be elitist or expansionist, and primarily concerned with either teaching or research. Elitist attitudes can fairly readily be associated with a preference for traditional single-subject departmental structures, but the implications of expansionist attitudes are less easily predicted and depend on the environment of the subject and the institution - the demands of the economy and of potential students for particular types of course, the preferences of funding authorities (local authorities, UGC, research councils, etc.). If these demands are for inter-disciplinary developments of new sorts then expansionism will lead to a weakening of subject boundaries and a potential preference for matrix-type structures.

These approaches, which refer specifically to higher education, can be supplemented by other more general considerations. Academic staff may in some respects be regarded as professionals, enjoying as they do monopoly of an esoteric and difficult body of knowledge, with recruitment by strictly controlled lengthy training, and with access to the profession controlled by the profession (see Becker (1962)). The implications of professionalism for intra-institutional conflict will be considered in III.iii below; here it can be noted merely that professionalism means a preference for 'closed' structures which maximise individual discretion and autonomy, and hence the scope for personal 'professional judgement'. The department scores higher on these criteria than does the matrix.

So far it has been implicitly assumed that teaching staff have, in Etzioni's (1961) terms,[3] moral commitment to their work. The recent struggles over teachers' pay in higher education have emphasised the importance of the economic dimension and suggest that in Britain we are perhaps seeing the trend Hartnett (1975, p.86) has described for America, where collective bargaining has meant, says Hartnett, that:

> "... academic tradition and the accompanying authority predicated upon values, rules, prerogatives, customs and past dispositions have been overthrown ... (and replaced by) the new phenomena of governance by contract, codification and legal checks and balances."

Clearly different bases for authority might require different structures for management - more 'checks and balances' to control academic performance, for example. Although a matrix would tend to favour codification and contract (through its emphasis on open inter-group negotiation) this tendency is likely to be more than balanced by trade union preference for clearly identifiable power figures (i.e. heads of department) with whom to conduct collective bargaining. The overall effect of a predominance of staff with a calculative[3] involvement in the institution is therefore likely to be a preference for departmental structures.

The people with most influence over organisation structure are likely to be the senior managers, so that their strengths and weaknesses must be taken into account. One virtue of a departmental structure is the wide variation it allows in management styles because of the autonomy of the department. There

seems to be some measure of agreement that a simple distinction between 'concern for people' and 'concern for production'[4] suffices to describe a good deal of variation in management style. People-centred and task-centred managers can each find niches in a departmental structure, whereas a matrix structure, which differentiates roles more sharply, is likely to call for greater flexibility and openness from managers, who are more likely to find their preferred style inappropriate in at least some situations. (In a matrix, managers come into contact with more people less often, so it is less likely that subordinates will learn and make allowance for the manager's personal preferences).

The importance of managerial values has been stressed by Argyris (1967), and Argyris and Schön (1974). Argyris (1967) suggests that managers tend to hold three basic values:

- getting the job done
- be rational, logical and communicate clearly
- people work best under carefully defined control

and that these values are consonant with pyramidal, but not with matrix organisations. Argyris and Schön (1974) suggest an alternative value system based on openness, valid information and free and informed choice, more likely to suit matrix operation. The prevalence of the former value set clearly means a preference for departmental structures.

Non-teaching staff organisation will tend to reflect the teaching staff structures, although many non-teaching roles - clerical and technical support for courses, for example - may be largely unaffected by a move from departmentalism to matrix or vice-versa. Many college staff are in any structure subject to dual authority - the departmental secretary, for example, may be responsible to both the head of department and the faculty administrative officer. A departmental structure will minimise the impact of such duality on the postholder, but a strong faculty administration or a matrix is more likely to create conflicting demands on non-teaching staff, and thus to create a need for staff and a non-teaching structure readily able to resolve such conflict. At Middlesex Polytechnic, for example, non-teaching staff are grouped in resource centres headed by senior administrators at faculty level, on hand to resolve problems as they arise.

Finally, the individual needs of students must be recognised. The advantage of a departmental structure is that it gives students, as well as staff, a reference point, a base and a source of identity within the organisation and it encourages the identification of students with staff, since all are in some sense members of the department. In a matrix structure the course will serve as a suitable substitute reference point to the extent that there is a reasonably small and identifiable body of staff associated with it. If not, the matrix requires special formalised arrangements to monitor the progress of individual students, which in a department one could often take for granted. It must be recognised that the matrix structure requires of students, as well as staff, a particular sophistication in discriminating between different roles and a particular willingness to accept a complex web of relationships with a wider range of staff in place of the simpler and less extensive involvement in the department.

III.ii. Technology

Technology has been accepted as a key influence on organisation structure since the pioneering research of Joan Woodward (1965), but in education, and especially in higher education, it is not at all easy to characterise the technology which is used - there are elements of mass production, of process production and of individualised craft production in the individual's learning experience. Cohen and March (1974) suggest that an organisation with unclear technology, problematic goals and fluid participation in decision making may be characterised as an 'organised anarchy', of which the archtype is the American college or university. The conclusion they draw is that there can be no structure for collective decision making:

> "... the term (academic) "policy" is probably somewhat misleading if it conveys a notion of systematic collective decision making. The set of activities that are subsumed under the general term "academic policy" are the organisation of academic departments, the organisation of the educational program (and so on) ... Academic "policy" is the accretion of hundreds of largely autonomous actions taken for different reasons, at different times, under different conditions, by different people in the college." (pp.103-4).

Yet if this is so a departmental structure can never be radically changed once it is established; Cohen and March also seem to imply that any alternative structure will soon lapse into departmentalism. Both these conclusions are contradicted by the experience of Middlesex and other polytechnics. The 'organised anarchy' model may be helpful for managers in some circumstances, but we cannot take it to be universally applicable. Consequently the implications for structure of the unclear HE technology are themselves unclear: for educational organisations it is more instructive to consider arrangements for co-ordination without specific reference to technology.

III.iii. Co-ordination

There is general agreement that teaching and research are the core activities of any higher education institution. Rice (1970) offers a useful elaboration of these two core activities by distinguishing: three kinds of operating systems for the education of students - teaching (instruction), supervising (intellectual development) and tutoring (personal development); and three kinds of research enterprise - the discipline-based department (for specialised research), the research institute (for a class of similar problems, or for multi-disciplinary research) and the research group headed by a 'tycoon', or authoritative leader. There are thus up to six types of task to be co-ordinated in some way. Rice (1970, p.8) sees the main problem as one of defining and managing boundaries:

> "Task management ... is essentially (a) the definition of boundaries between task systems (b) the control of transactions across boundaries."

The discipline-based department with primarily single-subject courses offers a strong boundary for all three tasks in the education of students, and also for specialised research. Extra-institutional funding of research projects permits the creation of temporary autonomous units alongside the permanent departments, so that a departmental structure is able to co-ordinate teaching and research tasks very effectively. However the price of this effectiveness may be an unfortunate balance between the different tasks - a strongly research-oriented department might, for example, fail to give due weight to the personal development of its students. Clearly it would be possible to separate the different tasks by assigning control of them to different staff of equal rank, and requiring these task managers to negotiate mutually acceptable solutions, and this clearer and more explicit differentiation is one aim of the matrix structure. However the management of task systems cannot, says Rice, be treated separately from the management of the social system of the organisation - there must be what Rice calls coherent 'sentient systems' as well as coherent task systems:

> "Management of an enterprise requires ... three kinds of boundary control: (a) regulation of task-system boundaries ... (b) regulation of sentient-system boundaries ... (c) regulation of the relation between task and sentient systems ... " (p.11).

The department merges task and sentient system boundaries, but the matrix must create sentient systems to replace the department if it is to be stable. The obvious candidate is the course, whose elevation is one of the principal aims of the matrix, and this suggests that particular attention should be given to ensuring some sense of permanence and continuity in course groupings of staff. Goodlad (1976, p.58) argues that:

> "Because disciplines are as much social groupings as intellectual entities, their acceptance or rejection depends as much on the distribution of power within an educating institution as on their relevance or irrelevance to pressing social problems."

Thus the adoption of a matrix structure backed by no more than good intentions will not succeed; new social groupings based on courses must be encouraged by in particular, changing reward systems to favour course activities. If publication remains the main criterion for promotion a matrix structure will revert inexorably to departmentalism.

### III.iv. Environment

It was suggested in the Introduction that new social pressures were a major influence making for structural innovation in HE. Burns and Stalker's (1961) classic study showed how organisations operating in volatile and changing environments were more likely to be successful if their structure was 'organismic' and flexible, as opposed to the more rigidly bureaucratic 'mechanistic' structures appropriate to stable situations. The survival capacity of the individual department is such that some departmental structures may become unduly mechanistic through a gradual hardening of established

patterns of work. It is, of course, possible for a formally departmental organisation to retain great flexibility, but this requires either a strong central influence or a sense of common purpose sufficient to over-ride departmental preferences from time to time. The matrix, on the other hand, is inherently organismic and therefore at an advantage in a rapidly-changing world, as we would expect from Lawrence and Lorsch's (1967, p.82) conclusion that:

> "... the evidence indicates that high differentiation plus effective conflict resolution lead to high integration, and these are the overall conditions organisations must attain to be effective in (a diverse and dynamic) environment."

This again stresses the need to give particular attention to the processes of negotiation between course and resource managers in the matrix; it will not suffice merely to create the formal possibility of greater cross-disciplinary development.

### III.v. Size

Ideas about the appropriate size for educational institutions seem to vary with context, to the extent that Devid (1976, p.106) trenchantly concludes that:

> "The chimerical pursuit of eternal constancies of educational organisation artifically abstracted from ... historical context should be abandoned."

Nonetheless variations in size do have implications for organisation structure, and Blau's (1970) careful analysis suggests that increasing size generates structural differentiation, and that structures seem to undergo repeated 'social fission' with growth. In a matrix social fission means the introduction of new courses and new subject groupings of staff, and this - being a less significant change in task and sentient system boundaries, and a more routine development - is likely to be a less traumatic process than the creation of a new department. The rate of change thus becomes crucial: as we have seen, a matrix is likely to be a more adaptable form in the face of rapid change, but in stable conditions it is likely that the department will be at an advantage. If, as Schumacher (1973, p.202) says, 'The fundamental task is to achieve smallness within large organisation' then the department is the ideal unit because of its simplicity. There seems to be little evidence to suggest economies of scale with increasing size under either structure (see Hempstock (1977)), and Knight (1976) reports that matrix structures are claimed both to promote efficient use of resources and to incur increased administrative costs. The effects of size, then, are equivocal.

### III.vi. Dispersion

The waves of institutional mergers which created the polytechnics, enveloped the colleges of education and continue with the formation of the institutes of

higher education have increased the importance of geographical dispersion as an influence on organisation structure. In the universities departments and faculties have tended to seek their own separate physical domains, whereas elsewhere geography has been more of an independent variable, particularly in the short term. The choice is essentially whether to acknowledge or to ignore geographical separation in the formal structure. It may be desirable to ignore dispersion so as to break down inappropriate loyalties to constituent colleges, but problems of intersite travel and communication must somehow be recognised. A departmental structure is more likely to take physical separation of sites in its stride, provided that no department is split between sites. Dispersion is more problematic for a matrix, which depends on cross-institutional perspectives for resource allocation and use. If sites are sufficiently large it might, of course, be feasible to establish 'site matrices' based on separate sub-institutional groupings of activities. Middlesex Polytechnic has opted for a single matrix despite being spread across a dozen widely-dispersed sites, and although there are undoubtedly extra costs in administering the system the operational difficulties have not proved insuperable.

### III.vii. Tradition

A discussion of influences on HE organisation would be incomplete without reference to the power of tradition in maintaining departmental structures. For many staff an alternative is literally unthinkable, and even for those prepared for radical change a matrix structure can be profoundly disorienting. Departmentalism is deeply embedded in the psychological, sociological and technological structures which dominate higher education, and it requires a very special set of circumstances to make any permanent alternative feasible.

## IV. SUMMARY: THE IMPLICATIONS OF MATRIX ORGANISATION

### IV.i. Teaching

The major impact of the introduction of a matrix structure in HE is, and is intended to be, its effect on teaching activities within the institution. The separate identification of the role of Course Leader is meant to increase the emphasis on co-ordination and balance of inputs to student programmes, and at a more general level to improve the potential for appropriate cross-disciplinary developments both within existing courses and by the creation of new courses. A matrix structure forces conflicts between course and resource dimensions to the surface and depends for its success on the effective resolution of such conflict. Wilemon's (1973) study of matrix organisation in the NASA Apollo project led him to formulate some general hypotheses about managing conflict in such organisations, which we can relate directly to the HE context. He suggests that conflict will be more likely, and more difficult

to manage if:

* there is a great diversity of disciplinary expertise
* the Project (Course) Leader has low authority
* objectives are not clearly specified
* there is little agreement on overarching goals
* roles are ambiguous
* members of traditional functional areas perceive their roles as being usurped
* there is a low perceived need for inter-dependence among organisational units
* higher managerial levels are involved within individual projects

Perhaps the greatest problems here are the authority of the Course Leader, the specification of roles and objectives, and the lack of agreement on overarching goals, although all the points strike responsive chords. At Middlesex Polytechnic the conjunction of 60 Course Leaders with only six Deans, who also chair Faculty Boards creates problems in the balance of Dean-Course Leader authority for both sides; the key problem seems to be the uncertain status of the subject group and the subject chairman within the resource centre. This has led to pressures internally and from CNAA for clearer definitions of roles and statuses in this area. This fundamental problem is aggravated by the diversity of disciplines, the tendency of former 'heads of department' to try to retain previous roles, and the size and dispersion of the institution - operational problems can be referred rather too readily to top levels where they will be harder, rather than easier, to resolve satisfactorily. The matrix, though, does tend to flush out and force solutions to problems such as bad teaching, both by making such problems more apparent and by increasing the emphasis on staff development as a primary responsibility of certain postholders. Of course the simplest way to improve teaching may be to give quality of teaching more weight as a criterion for promotion - the obvious difficulties of assessment of quality do not weaken the force of this point, and it has already been suggested that a matrix structure will be unstable if reward systems are not appropriately structured too.

The matrix makes (or attempts to make) the course, rather than the department, the basic unit of organisation. The effect of creating this smaller formal unit is to make it less susceptible to central control, but more susceptible to influences at grassroots level from subject groups, etc. The network of relationships therefore becomes more explicitly 'self-organising', to use Beer's (1966) term, and for the individual teacher this means a great deal more autonomy, a great deal more scope for negotiating his or her own work programme, and wider opportunities for interaction with other staff. The necessary accompaniment to this autonomy is greater control over the teaching activity itself - tighter course objectives, more rules, more guidance, more (and more explicit) assessment of teaching, and so on. It may be too soon to judge, but it is not clear from the experience of Middlesex Polytechnic that these changes improve either the quality or the co-ordination of teaching, The claimed advantages of the matrix may be as difficult to achieve as they are to assess.

IV.ii. Research

Insofar as research in higher education is essentially an individual activity separately funded, the effects of a move from departmental to matrix organisation are likely to be slight. Rice's (1970) 'tycoon'-style research already follows the project form of organisation which Rice argues is more appropriate, and necessarily so because of the nature of external funding which requires identifiable research project leaders. In the private sector, matrix forms of organisation are often associated with collaborative research and development activities.[5] The advantages claimed for the matrix include flexibility in conditions of change and uncertainty, the facilitation of technical excellence, improvement of motivation and commitment of staff, and increased opportunities for personal development. Thus we might expect collaborative and perhaps inter-disciplinary research in HE to be encouraged by a matrix organisation in which 'research institutes' (see p.10 above) might more easily flourish. In a matrix the establishment of a research institute should be a less threatening structural change than it would be in a departmental structure, where the departments would probably claim the research institute to be an unnecessary step and argue that existing departments could tackle the desired research (with the proposed additional resources!).

It is doubtful whether specialised research, whose natural home is the discipline-based department, would suffer unduly under a matrix structure. The incentive to 'publish or perish' remains strong for cosmopolitans irrespective of structure and the more extensive interactions in a matrix would presumably be enriching. The Middlesex experience may not be a good guide because of the small research base in the institution, but considerable senior staff commitment to developing research has to date enjoyed only limited success, even though most staff perceive publication to be the main route to promotion. If this perception were changed some research activities would presumably be inhibited. The arguments above for changing reward systems to favour good teaching in a matrix suggest that a balance must be struck between conflicting demands for teaching and research. In a departmental organisation each department may strike its own balance; the matrix makes it more likely, though not inevitable, that the balance will be openly negotiated and defined for the institution as a whole.

IV.iii. Support Activities

Four main support activities may be identified: libraries and other learning resources; student 'welfare' services; provision of physical resources; and administration and other non-teaching staff services. For the library the matrix will mean the ending of familiar patterns of contact with departmental representatives. New links must be established with both course and subject staff, and new demands must be expected from previously unsupported directions of inter-disciplinary collaboration. It may be helpful to retain library committees and other formal or quasi-formal means of communication to ease the transitional problems. For library staff, as for most

others, the matrix may force out into the open difficult decisions over conflicting demands (especially teaching-v-research) which previously were implicitly resolved either within the departments or within the library: open and collaborative resolution of such problems will increasingly be required.

For student services the effects of a change to matrix organisation may be less marked. There will, of course, be difficulties caused by the abolition of familiar departmental channels of communication, but such channels are perhaps less important for services such as health and accommodation which will tend to operate on a site - or institution-wide basis. The matrix might, however, increase the emphasis on the arrangements for pastoral supervision - Rice's 'tutoring' - and may thereby increase the status and awareness of the importance of student services within the institution.

For managers of physical resources the ending of departments will perhaps mean the ending of 'departmental teaching rooms', and a greater centralisation of control over the allocation and use of space. Who wins the perennial battle of wits between controllers and teachers, though, will probably depend on who first gets to grips with the new organisational rules.

The new rules make it necessary for staff to communicate with a wider range of others, and for more differences to be resolved openly by negotiation. The consequence of this will be an increase in administrative costs and there will, in the short term, be no corresponding benefits from improved co-ordination and quality of performance. The introduction of a matrix structure therefore requires an investment in administrative and clerical staff which will only be repaid over several years.

IV.iv. Conclusions

How do we judge an organisation structure? According to Sir Robert Aitken (1966, p.80):

> "The test of its aptness for its purpose is whether it allows the maximum freedom within wide limits, whether it finds the optimum point of balance between diffusion and concentration of responsibility for academic management, and whether it keeps the tension between the individual and the organisation down to a level that is healthy for both."

The supporters of matrix structures would argue that by all these criteria the matrix is superior to its departmental alternative. Yet, as we have seen, such superiority has its price. The introduction of a matrix is an attempt to legislate for innovation. The conditions for success are not merely concerned with achieving the necessary restructuring. There must be a willingness to incur extra costs in the short term, before any benefits become apparent, managers must be prepared to adopt a flexible approach and

adjust their style to suit different contexts, and staff must be prepared to operate in a new environment which makes much greater demands for individual self-validation. The matrix represents a revolutionary, rather than evolutionary, change for all but the most flexible departmental organisations. For that reason the strategy for achieving that change must be carefully chosen. Benne and Chin (1969) distinguish three broad types of strategy - empirical-rational (based on rational argument and persuasion), normative-re-educative (based on attitude and value changes), and power-coercive (depending on superior force or authority). The introduction of matrix structures in some polytechnics hinged on empirical-rational and power-coercive opportunism when the new institutions were created, yet the prime requirement for success must be appropriate changes in the attitudes and values of the staff. While structural alterations can induce some of the necessary changes (as Walton (1969) has shown) there remains a need for a continuing programme of training which amounts to organisation development. The effectiveness of any change depends crucially on the ability of staff to reorient themselves, for otherwise what are meant as new opportunities may be perceived only as new threats. In Argyris's (1967, pp.47-48) words:

> "... changes in organisational structure do bring about intended changes in people's behaviour... However, they also bring about unintended behavioural changes; the restraining forces are strengthened, and the organisational tension level is greatly increased."

To overcome these difficulties great responsibility must be placed on senior and middle managers:

> "... I believe that the organisations of the future will be a combination of the old and the new forms ... In addition to being able to differentiate clearly between the old and the new forms, the future executive must also be able to know the conditions under which he will use the different organisational forms. Moreover, he will need to become skilful in several different kinds of leadership styles, each of which is consistent with a particular form." (p.49)

The dice are loaded against the matrix in higher education. The prime responsibility for making a matrix work must fall on the heads of department - the very people who have most to lose under the new structure. If these are, as Argyris calls them, 'today's problems with tomorrow's organisations' then HE is in for a painful transition process, and change will continue to be something enforced by outside pressures rather than embraced by internal vision. This is the most compelling, perhaps the only, reason for encouraging the structural experiments which have so far not fulfilled their promise.

NOTES

1. Knight (1976) reviews the origins and diffusion of matrix forms of organisation. The development of matrix organisations among contractors for the American space programme (as described by Wilemon (1973), for example) was at least partly due to federal government's insistence on clear lines of accountability for particular projects, leading to the designation of project managers with responsibilities cutting across the normal functional divisions - marketing, production, finance, etc. The new structures spread across the Atlantic via international and multi-national companies such as BAC (see Brooks (1970)) and ICI.

2. In industrial manufacturing contexts the term 'project organisation' is also often used.

3. Etzioni (1961, p.45) distinguishes moral, calculative and alienative types of commitment as bases for compliance. He sees educational organisations as relying primarily on moral commitment: 'Educational organisations characteristically employ normative controls with coercion as a secondary source of compliance.'

4. This is Blake and Mouton's (1969) terminology. Other writers give other labels to much the same distinction - see Hollander and Julian (1969).

5. Koontz and O'Donnell (1976, pp.317-322) report that matrices are commonly found in high-technology engineering, research and marketing - all three having a strong research/development orientation.

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